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LEARNING STYLES AS PREDICTORS OF PROBLEM-BASED LEARNING SUCCESS IN THE INFORMATION SYSTEMS CLASSROOM

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ABSTRACT

Problem-Based Learning (PBL) is increasingly used as a mode of instruction to more fully engage students, while at the same time promote self-learning and retention. For many students, PBL is a welcome change from traditional professorial lecture approach. In practice, however, some students do not thrive in this less structured environment. We utilize theories of learning styles to shed light on this apparent tension. This paper develops an approach to arrive at a predictive model of how learning styles determine student acceptance of problem-based learning. First, a chronological view of PBL and the learning style literature is provided. This is followed by a discussion of the research constructs, methodology, and survey instruments to be used to predict the efficacy of PBL techniques, based on learning styles. We use Felder and Solomon's (1996) freely available and widely validated instrument to assess student learning styles, and develop this predictive model through data analysis using Principle Least Squares (PLS). This model will be used to form specific hypotheses which can be tested further. A discussion of how the results from this study may aid professors, and thus benefit students, is then presented.

Keywords: problem-based learning, learning styles, predictive education research

I. INTRODUCTION

Preparing a labor force for a constantly changing industry is an on-going challenge, when in many areas of information systems education where technology quickly dates the content and offers new solutions to business problems. To meet this challenge some professors are moving away from a traditional lecture approach where textbooks are often out of date and moving towards a PBL approach, which parallels how students are expected to learn "on the job." In problem-based learning, students learn from "authentic problems… encountered in the learning sequence, before any preparation has occurred" (Felder & Brent 2005). In adopting PBL, faculty hope to be more effective at developing the skills and knowledge necessary to meet today's workforce needs (Gijbels et. al 2005).

In practice, faculty who initially try a problem-based approach find that while some students thrive in this environment, others do not (Markham & Olsen, 2008). This may come as a surprise to a professor who has made a considerable time investment to change to a new teaching method. For this reason, we seek to develop a predictive model of how learning styles determine student satisfaction with PBL.

We postulate that differences among student learning styles can explain their satisfaction with PBL teaching methods. As such, we seek to predict which students will do well in a PBL environment based on their learning styles. The implication of this for instructors is also discussed.

We will first review the literature regarding problem-based learning and learning styles. Next, we will propose a research methodology that will yield a predictive model of PBL acceptance. Finally, we discuss how the results of such a study might aid professors and students in the classroom.

II. LITERATURE REVIEW

PROBLEM-BASED LEARNING

Many aspects of PBL stem from the long history of education and education research. For example, Socrates challenged his students with questions as his mode of instruction and required them to search for new ideas and debate them in a scholarly environment.

Problem-based learning, as it is discussed in academic circles, originated at the then newly established School of Medicine at McMaster University in Hamilton, Ontario, Canada in the 1960s. Since that time it has been applied to many disciplines (Barrows, 1996) such as accounting (Springer & Borthick, 2007), and computer science (Fjuk 2004).

Although many definitions of PBL exist, one common theme is that of concrete problems that initiate the learning process. Boud (1985) states, "the starting point for learning should be a problem, a query or a puzzle that the learner wishes to solve." Barrows (1996) develops a model based on the method originally used at McMaster University, which we outline below:

1) Learning is student-centered
2) It occurs in small groups
3) The instructor plays the role of facilitator or guide
4) Authentic problems are presented before any preparation or study has occurred
5) Problems are used as tools to achieve the required knowledge and the problem-solving skills necessary to eventually solve the problems
6) Information is acquired by self-directed learning from many contexts

It is claimed that students in a PBL environment gain a command of key principles and phenomena and their relationships in a domain of knowledge -- not just a patchy understanding of concepts. Students also come to know the conditions by which their knowledge can be applied to solve a problem. The general goal of PBL can be described as "successful problem solving in two

dimensions: the acquisition of knowledge and the application of [that] knowledge" (Gijbels et al., 2005).

LEARNING STYLES

Theories about why people behave and learn differently have been postulated for thousands of years. The four personality types of choleric, phlegmatic, melancholic, and sanguine come from the names of Hippocrates four bodily fluids or humors. He believed the right balance of these produced emotional and physical health (Keirsey, 1998).

In modern times Carl Jung theorized everyone naturally leaned toward a set of three opposing preferences. These formed the basis of the famous Myers-Briggs Type Indicators (MBTI). Since the development of the MBTI in the 1940s, many other scales that incorporate learning styles and are based on Jungian principles, have been developed (Nelson, 2005).

There has been no shortage of research on learning styles. Bibliographies on learning style research since 1971 reference over 1,000 unique articles (Coffield, 2004). Yet, even with much research on learning styles, the concept is not universally accepted. Some academic communities argue, with considerable emotion, that instruments used to assess learning styles are not appropriately validated. However, there are many studies that explain learning style differences with clarity and consistency. Such studies conclude that instruction methods, which incorporate a large range of learning styles, are more effective than traditional methods, which embrace fewer learning styles (Felder & Brent, 2005).

Research in the last two decades has developed many learning style instruments that are available at no cost, maintain external validity, and are short in length (Felder & Soloman 2008; Fleming, 2007; Coffield et. al 2004; Felder & Silverman, 1988). These instruments are able to quickly assess a student's learning style through a series of short questions, and are easily administered online. Further, there is research that has compared and contrasted these instruments, primarily based on Jungian principles (Coffield, 2004).

Predictive research has recently been illustrated as an integral part in improving the educational system in the United States. Christensen (Christensen et. al 2008) calls for rigorous predictive education research, to which this work responds.

III. PLANNED METHODOLOGY

DATA COLLECTION

A validated learning-styles survey instrument will be used to collect data from students at the start of the semester of a Business Process Management undergraduate course at a large urban university in the Southeast United States. The class consists of 22 students taught using problem-based learning techniques, from an instructor who had one semester of prior PBL experience. The results of the learning styles instrument will not be shared with the students until the last day of the semester to avoid selective response bias. The students will complete a survey before the last day of the class that will assess their satisfaction with the problem-based learning environment, and prior experience with the subject matter.

Felder and Soloman have created a learning style instrument, which has been widely used in engineering and technical disciplines, and is freely available on the internet for non-business use (Felder & Soloman 2008). The instrument consists of 44 questions that measure four dichotomous constructs of learning styles. These include Active vs. Reflective, Sensing vs. Intuitive, Visual vs. Verbal, and Sequential vs. Global learning styles. The degree to which a student is dominant in one of the learning styles is reflected in the scale of the instrument. In our initial model (Figure 1) these learning styles are portrayed as reflective latent constructs formed by 11 response item variables.

Of the many learning style instruments available, this model was chosen for four main reasons. First, the instrument was designed for college-age students. Second, the survey is freely available for non-business use, unlike many of the

Keirsey and MBTI-derived tests. Third, completing the instrument takes less time than others.

Finally, many scholars have soundly tested the validity of this instrument including Felder and Spurlin (Felder & Spurlin, 2005), Zywno (2003), and Litzinger et. al (2005). To avoid the negative effects of pooling the data, and to aid in data analysis, we have slightly modified the measurement scale of the instrument. Figure 1 shows the measurement model that we will use in our theory-generating process.

Data collection will resume the last week of class when students will respond to an online survey, using a seven point Likert scale to gauge their satisfaction with problem-based learning.

Students will also be asked open ended questions about their satisfaction with the course overall, and with problem-based learning. This qualitative data will be used to understand the quantitative data, thus aiding in data triangulation, and will serve as a useful base for theory generation.

DATA ANALYSIS

The method of Partial Least Squares (PLS), and the software package SmartPLS (Ringle et. al 2005) will be employed in the analysis of the data. As we seek to build theory, a model will be *developed*, not tested, in the data analysis stage. PLS has been found to be especially useful in areas where there is weak theory and limited understanding of relationships between variables (Wold, 1982). PLS is also effective with smaller sample sizes as compared to covariance based approaches such as structural equation modeling. To further inform our theory building process, and as a means of data triangulation, a qualitative analysis will be done on "free response" items of the survey.
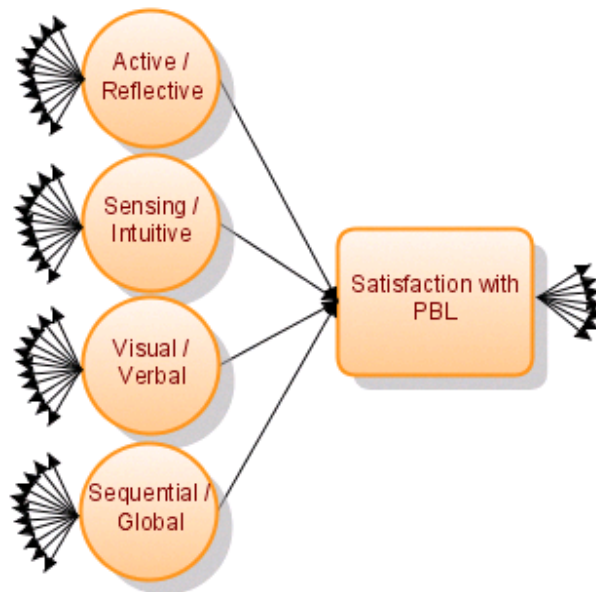
Figure 1: Satisfaction with PBL predicted by learning styles
Measurement Model

As this is an exploratory and theory building study, we will not be testing hypothesized relationships between the latent variables in our model. The intent of this study is to help establish a predictive relational model that can be further tested.

IV. LIMITATIONS

The limitations of this study mainly consist of a lack of generalizability. As no two professors teach alike, and no two classes consist of the same students it is difficult to assert that our results will be applicable in similar situations. However, generalizability of our results is not the purpose of this work. We seek to use this initial study to inform a predictive theory of student satisfaction with PBL, based on their learning styles.

V. CONCLUSIONS

Switching from more traditional teaching methods to PBL requires much effort on the part of the professor. By becoming aware of student's learning styles and how they might affect their learning abilities in a problem-based learning context,

professors may avoid being surprised by finding students who do not thrive in this instruction environment, and more easily make the transition to a new teaching method. More broadly, faculty may be able to adopt hybrid approaches that reflect a number of different teaching approaches to, in turn, accommodate a diversity of learning styles and benefit all students.

The results of this study may help faculty predict the success of PBL techniques in their classrooms based on student's learning styles. This could drive the customization of teaching techniques better matched to the needs of individual students. Follow-up research could potentially describe which learning resources (e.g. textbooks, lectures, online demos, role-plays, online discussion groups, observation assignments, and team projects) are most useful based on the known learning style of the student.

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